
Wisconsin Karner Blue Butterfly Habitat Conservation Plan and Environmental Impact Statement

Chapter 2: Statewide Karner Blue Butterfly Habitat Conservation Plan (HCP)

B. Karner Blue Butterfly in Wisconsin

1. Importance of Conservation Measures to Karner Blue Butterflies in Wisconsin

Insects are a vital part of prairies and other plant communities, and although *there have been no reported extinctions of prairie insects*, a number of insect species have declined seriously (Pyle, *et al.* 1981). Invertebrates, however, are often not considered in conservation efforts. Most prairie reserves or parks are managed with maintenance of plants or particular vertebrate species as the focus. Other lands with prairie or similar habitats are managed for a variety of economic purposes unrelated to conservation. Success or failure of property management plans, where they exist, is generally based on the maintenance of the overall prairie habitat (Opler 1981) or other economic outcomes.

The Karner blue butterfly is representative of many species that are threatened with extinction, as anthropogenic modification of whole landscapes causes the loss of habitat (Andow, *et al.* 1994). Today, the disappearance and fragmentation of the pine and oak savanna habitats, through a variety of causes, has been a major contributor to the range-wide decline of the Karner blue butterfly (USFWS 1992a, 1992b; and works cited therein). In addition, natural plant succession in these habitats has eliminated Karner blue butterflies from some areas.

In locations other than Wisconsin and Michigan, the abundance of Karner blue butterflies has declined significantly. Karner blue butterflies have been extirpated from Iowa, Ohio, Ontario, Maine, Massachusetts, New Jersey and Pennsylvania, appear to be extirpated in Illinois, and persist in only remnant populations in Minnesota, Indiana, New York and New Hampshire (Iftner, *et al.* 1992; Baker 1994; Packer 1994; USFWS 1997). Because of this disappearance and the relative abundance of this species' populations in Wisconsin and Michigan, Wisconsin plays an important role in protecting Karner blue butterflies. Other locations where the butterfly occurs can also play a role in securing its future.

While many of the extant Karner blue butterfly populations occur on public lands (see discussion of Karner blue butterfly distribution and abundance, pages 57-59) which will be managed with consideration for the butterfly, it has become increasingly clear to conservation interests that species conservation cannot occur on public lands alone. There are simply not enough acres in public ownership to provide long-term stewardship. In addition, species like the Karner blue

butterfly depend on active land management which results in the perpetuation of particular habitat types.

There is reason to believe that small, isolated insect populations that persist on small sites may do so precariously (Panzer 1988). In general, small populations are subject to debilitating effects of demographic instability, genetic deterioration and natural catastrophes (Wilcove 1987). Several attributes, including fluctuating population densities, relatively poor dispersal abilities and patchy distributions make remnant-restricted insects particularly susceptible to extinction from these phenomena (Panzer 1988). Butterflies that specialize on plants found primarily in early successional habitats track an ephemeral food supply that is dependant on unpredictable ecosystem disturbances. For such species, suitable habitat can be a shifting and increasingly smaller fraction of a greater landscape mosaic that results in local species extinction events that are both frequent and inevitable (Cushman and Murphy 1993). Karner blue butterflies appear to have all of these characteristics. As such, the availability -- or absence -- of suitable habitat mosaics will play a key role in the long-term survival of the species.

The amount of conservation that can be accomplished on private lands for which there are economic goals depends on landowner flexibility in time, space and financial strategy. In principle, the most intensive conservation measures for Karner blue butterflies are concentrated on public lands. However, the role of private lands cannot be under-estimated. Large scale, multi-level conservation is best accomplished with statewide planning in which the participants accept various levels of responsibility for plan implementation. The Wisconsin Karner Blue Butterfly HCP was constructed with this concept in mind.

2. [Elements of Karner Blue Butterfly Ecology](#) ^{4a}

This section provides a brief overview of Karner blue butterfly ecology. More detailed biological information is provided in Appendix A.

Autecology. Numerous field observations and laboratory-rearing experiments have documented aspects of Karner blue butterfly life history (see Figure 2.6, page 50), but there still remains insufficient data to construct a life table -- e.g., mortality rates and life expectancy for Karner blue butterfly populations (Premo, *et al.* 1994). Life history and population biology data are relevant to and necessary for sound conservation management.

Karner blue butterflies emerge as a "spring flight" of adults in May or June and are active through mid- to late June in a typical year (Klots 1951, Bleser 1993, Swengel and Swengel 1996). Small variations in local phenology of Karner blue butterfly life stages apparently relate to climatological factors as well as site aspect, topography and the resulting microclimate (Haack 1993, Swengel and Swengel 1996). Karner blue butterflies complete two generations each year

throughout its range (i.e. they are a *bivoltine* species).

During the spring flight, females have been observed to mainly oviposit on, or near, lupine plants (Bleser 1993). Estimates of female fecundity [may](#)^{4b} vary from a low of 22 to approximately 100 eggs (Premo, *et al.* 1994). Eggs hatch in about a week (Scudder 1889), and larvae feed for about three weeks and then pupate (USFWS 1992b). The chrysalis is suspended from a sheltered place on the lupine stems (Cryan and Dirig 1978, Haack 1993) or deposited in the leaf litter (Packer 1987, Haack 1993). Although pupae have rarely been observed in Wisconsin (Bleser 1993), pupation in the leaf litter is typical of other lycaenid butterflies (Opler 1995). Eclosion (emergence of the adult butterfly) occurs in about eight days (Cryan and Dirig 1978).

The second, and often larger, "summer flight" occurs from about mid- to late July through early or mid-August in a typical year (Bleser 1993, Swengel and Swengel 1996). During this flight, females oviposit at or near the bases of lupine, on the dying lupine pods, low on the stems of surrounding vegetation and in plant litter (Cryan and Dirig 1978, Packer 1987, Haack 1993). Eggs from the summer flight overwinter and hatch in the spring of the following year (Scott 1986, Opler 1995).

Generally, male Karner blue butterflies are believed to emerge during both flights shortly before the females, resulting in males being observed more frequently than females early in the flight period (Bleser 1993, Leach 1993, Swengel and Swengel 1996). However, the overall sex ratio throughout the entire spring and summer flights is believed to be one-to-one (Haack 1993; Premo, *et al.* 1994).

Research examining Karner blue butterfly dispersal suggests that dispersal rates and distances are rather low (e.g., Bidwell 1994, Lawrence 1994); the maximum dispersal distance typically cited for Karner blue butterflies (slightly over 0.6 miles or one km) is of the same magnitude found for other blue butterflies (Lawrence and Cook 1989, Opler 1995). King (1996) recorded the longest dispersal distance for the Karner blue butterfly as 1.8 miles (9,732 feet for a female and 9,544 feet for a male) in a very open landscape. Long distance movements (>4,950 feet) were relatively common; 7.5 percent of the population studied moved this distance (King 1996). In another study examining dispersal, Bidwell (1994) observed a maximum dispersal distance of 5,280 feet for males in study areas where the tree canopy was relatively closed. Both researchers believed that these numbers probably represent *minimum* dispersal distances. It is clear from these studies that dispersal distance varies depending on land cover. It is unknown what intrinsic factors or environmental conditions stimulate dispersal. Additional information on dispersal is included in Appendix A, and research related to dispersal is discussed in Part D of Chapter II (pages 118-119).

Karner blue butterflies are theorized to have a metapopulation structure (defined here as a population of populations). Each individual population within a metapopulation is referred to as a "local population" (defined here as groups of individuals living in the same habitat patch -- a

continuous area of resources specific to the species surrounded by unsuitable habitat). Several metapopulation models have been suggested (e.g., Boorman and Levitt 1973, Gilpin and Hanski 1991, Thomas 1995), and Karner blue butterfly metapopulations may follow any of the models. Additional information on changes in population structure and metapopulation dynamics is included in Appendix A and the USFWS's working draft Recovery Plan.

Synecology. The natural habitats that Karner blue butterflies are found in are sandy pine and oak barrens, pine prairies, oak savannas and along lake shore dunes (Klots 1951, Howe 1975, Opler and Krizek 1984). Current Karner blue butterfly habitat in Wisconsin includes abandoned agricultural fields, mowed utility and road rights-of-way, managed forest lands, military training areas and bombing ranges and managed barrens (Cathy Bleser, Lepidoptera Coordinator, Bureau of Endangered Resources, Wisconsin DNR, pers. comm.). Karner blue butterflies are found in close association with wild lupine (*Lupinus perennis*), the only known host plant for their larvae.

A common feature of Karner blue butterfly habitats is a range of canopy cover from nearly full sun to semi-closed canopy or a pattern of patchy openings within a forested habitat. These conditions permit full sunlight to reach understory plants, allowing wild lupine to thrive (Savignano 1994a). Adult Karner blue butterflies have been found to be associated with areas with less than five percent tree canopy cover (Lane 1994). This may be due to increased quantity and quality of the food resources, effects on microhabitat, natural enemies, behavior, or other unknown variables in these areas (Lane 1994). Grundel, *et al.* (1998) found a higher rate of larval presence in shaded than sunny lupine patches, but in absolute terms, very few larvae occurred in shaded areas and by far most larvae were in sunny areas. Swengel (1995b) found a significant relationship between larval and adult densities, and Swengel and Swengel (1996) found a consistent strong association between increasing adult density with decreasing canopy cover.

Wild lupine is a member of the pea family ([Papilionaceae](#)^{4c}), with two identified varieties: *Lupinus perennis* var. *occidentalis* and *L. perennis* var. *perennis*. Lupine has been reported throughout much of Wisconsin; Figure 2.7 (page 57) shows the locations of University of Wisconsin Herbarium records for lupine as mapped by DNR personnel. There are relatively few records for this plant.

Peak lupine bloom typically occurs from mid-May until late June, but varies depending on weather, degree of shading and location within its range. Plants in dense shade rarely flower. Lupine is an early successional species adapted to survive on dry, infertile soils. Even very young seedlings have long tap roots that presumably allow lupine to reach soil moisture. Further, lupine can grow in soils low in nitrogen because of its association with nitrogen fixing bacteria (Zaremba and Pickering 1994).

Swengel (1995b) examined larval and lupine phenology in the spring in Wisconsin and described the feeding patterns characteristic of Karner larvae. She found the main period for finding spring larvae was the first to third weeks of May, and that larval size correlated positively with lupine height suggesting spring lupine and larval phenology are synchronized (Swengel 1995b).

Wild lupine appears to be declining throughout its range and many sites of former occurrence have been extirpated ([Boyonowski](#)^{4d} 1992, Grigore 1992, Cuthrell 1990). The primary cause of this decline appears to be habitat loss and degradation from development, agriculture and interruption of disturbance processes.

Karner blue butterfly larvae have a mutualistic relationship with a variety of ant species. Karner blue larvae possess specialized glands that produce secretions rich in carbohydrates and amino acids that ants use as food. The ants provide protection from larval, and possibly pupal, predators and parasitoids (Savignano 1990, 1994b; Swengel 1995b). This relationship with ants may in part explain the Karner blue butterfly's affinity to wild lupine. Many larvae of butterflies in this family actively prefer nitrogen-rich foodplants and plant parts such as seed pods and flowers that enable the larvae to supply ants with amino acids as a "nutrient reward" (Pierce 1984, 1985; Savignano 1994b). Additional information regarding these relationships is included in Appendix A.

Adult Karner blue butterflies use a variety of nectaring plants, with horsemint (*Monarda punctata*) being one of the most frequently used in Minnesota (Lane 1994). Schweitzer (1989) suggested a preference for butterfly weed (*Asclepias tuberosa*) and Jersey tea (*Ceanothus*) in New York Karner blue butterfly populations. Bleser (1993) includes a list of 69 confirmed nectaring plant species used by Wisconsin Karner blue butterflies and identifies the most frequently used of these. Additional information on adult nectaring sources is included in Appendix A.

Adult Karner blue butterflies have been observed roosting in both open and closed canopied areas during the day on several woody and herbaceous plant species. At night adults have been found roosting in the open on grasses such as big bluestem (*Andropogon gerardii*) (Schweitzer 1989), and Maxwell and Givnish (1993, 1994) found a positive correlation between adult Karner blue butterfly abundance and tall grass cover.

Other plant and animal species associated with Karner blue butterflies are identified in Chapter IV (pages 256-263) and discussed in greater detail in Appendix B.

Figure 2.6 Karner Blue Butterfly Life Cycle Illustration (Drawing by David Kopitzke, Wisconsin DNR)

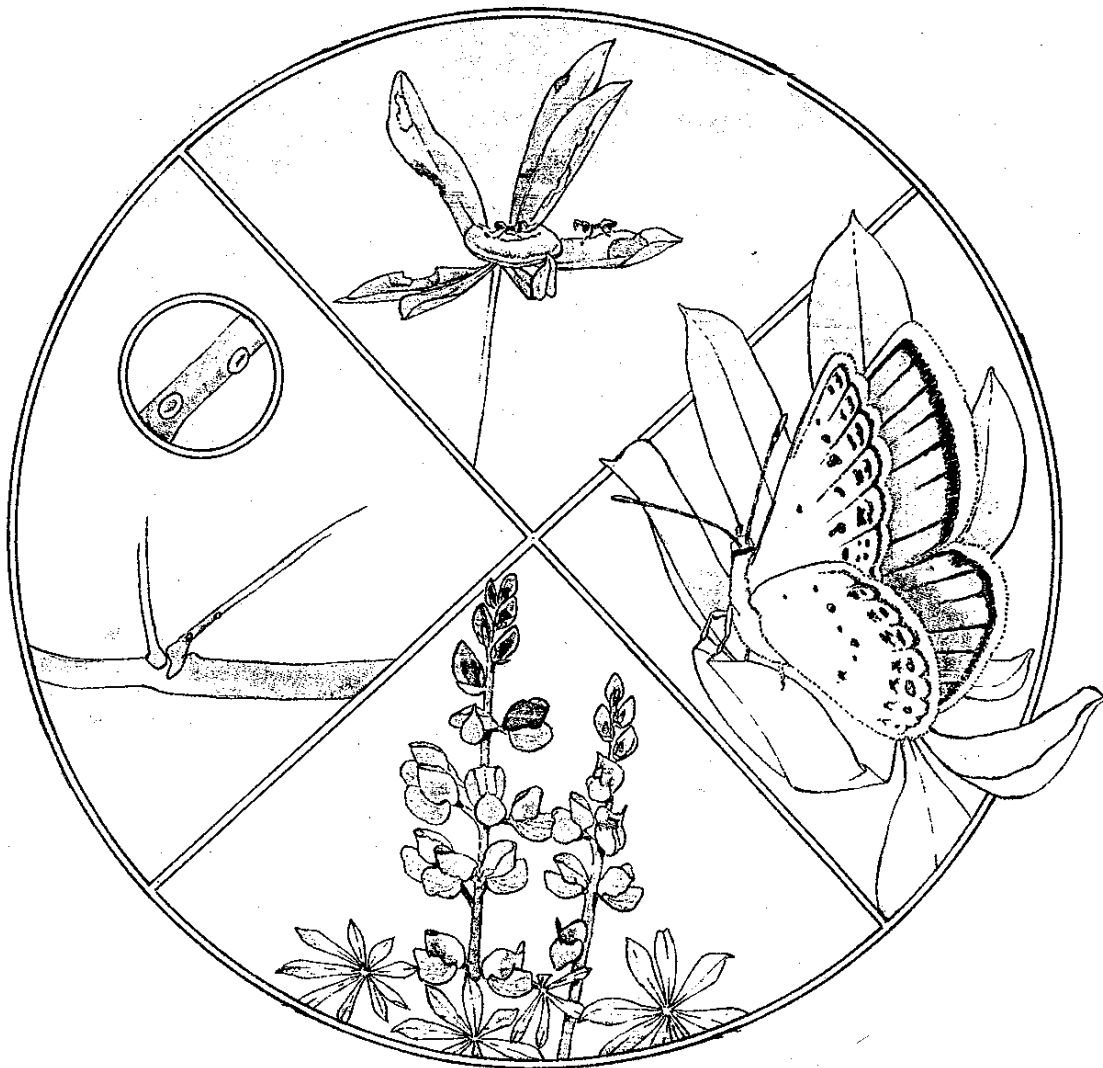
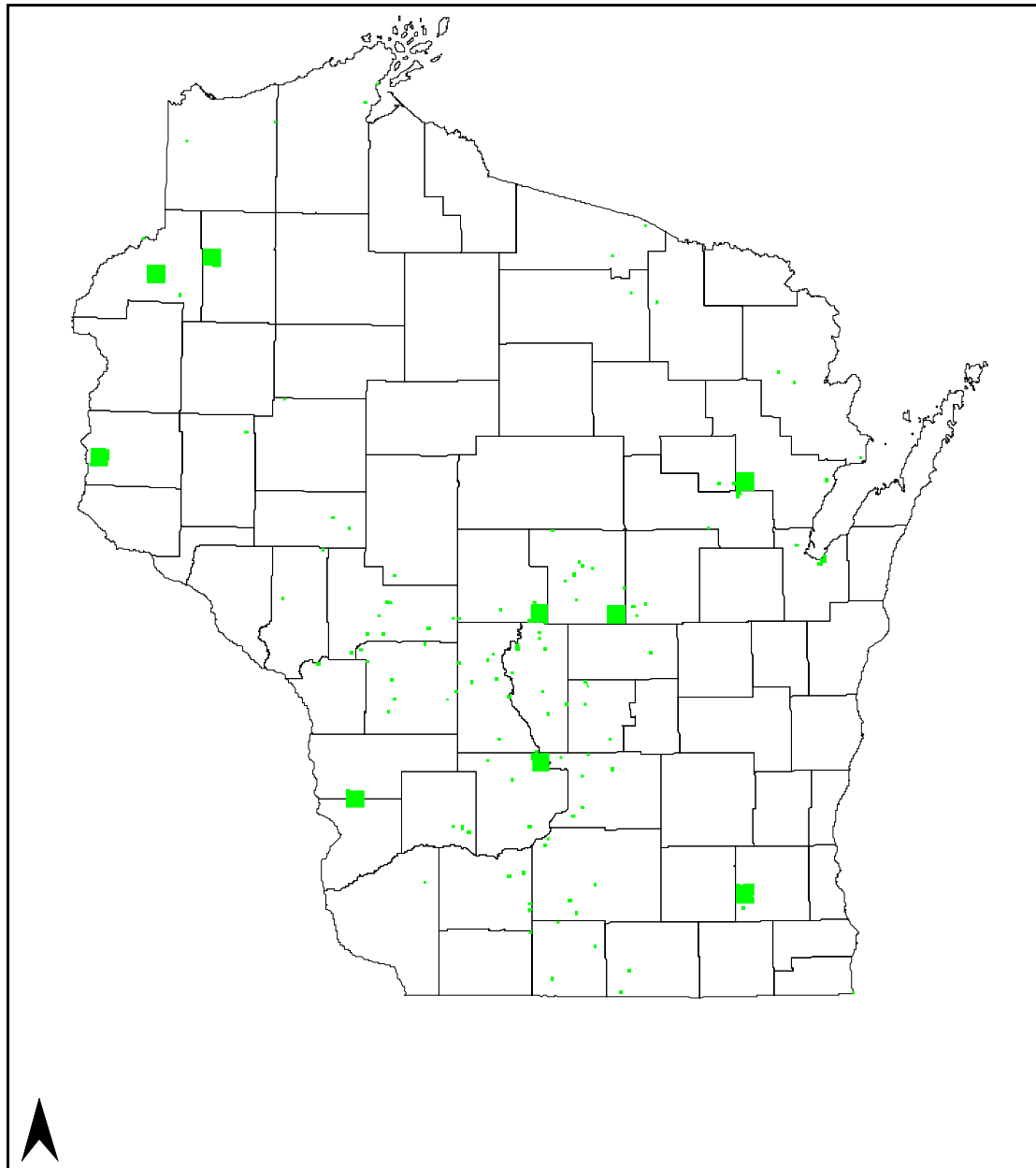


Figure 2.7. Locations of University of Wisconsin Herbarium Records for Wild Lupine (*Lupinus perennis*)



3. Distribution and Abundance: Potential Karner Blue Butterfly Habitat

This section briefly describes the distribution and abundance of known and potential Karner blue butterfly habitat. Potential habitat is defined as habitat that will meet certain biotic and abiotic conditions to support wild lupine at any point in time. Known habitat is defined as those surveyed areas where wild lupine has been found and which can support Karner blue butterflies. Known-occupied habitat is an area that currently supports Karner blue butterflies in association with wild lupine.

Potential habitat at the specific site level can only occur where abiotic and biotic conditions exist to accommodate wild lupine. Given the knowledge of certain ecological criteria such as the distribution of wild lupine, general soils information and climatic parameters relating to the Karner blue butterfly, potential habitat distribution and abundance is somewhat predictable. However, site-specific ecological information is not detailed for the state of Wisconsin. General ecological information for the entire state is available only at a very coarse scale of resolution.

To assist the HCP partners in predicting where potential Karner blue butterfly habitat may occur throughout the state, climate, bedrock type, soil characteristics, State Soil Geographic Data Base for Wisconsin (STATSGO), surficial deposits and herbarium records for wild lupine (Figure 2.7, page 51) were studied. These data sets, with the exception of the known wild lupine occurrences and climate data, were available in digital format. Geographic information system (GIS) technology was used to develop a map.

Bedrock type and surficial deposits were evaluated and indicated no visual correlation to known wild lupine occurrences. Soils within the soil characteristics data set that have a sandy soil association showed the greatest correlation with known wild lupine sites. To assist in validating the map, the 1992 and 1993 known Karner blue butterfly element occurrences in Wisconsin DNR's Natural Heritage Inventory database were used. This database is an integrated system of computer databases, maps and manual files that document the historical and current occurrence of rare plants, animals and natural communities in Wisconsin. Over 90 percent of the element occurrences fell within the sandy soil associations identified by the soil characteristics data base. The map identified approximately nine million acres of Karner blue butterfly potential habitat. This map was developed based on the best available information with the understanding that enhancement would occur as additional information becomes available and is evaluated. This "first generation" Karner Blue Butterfly Potential Habitat Map (Figure 2.8, page 53) was approved by the HCP Partners in December 1994.

Figure 2.8. First Generation Karner Blue Butterfly Potential Habitat Map

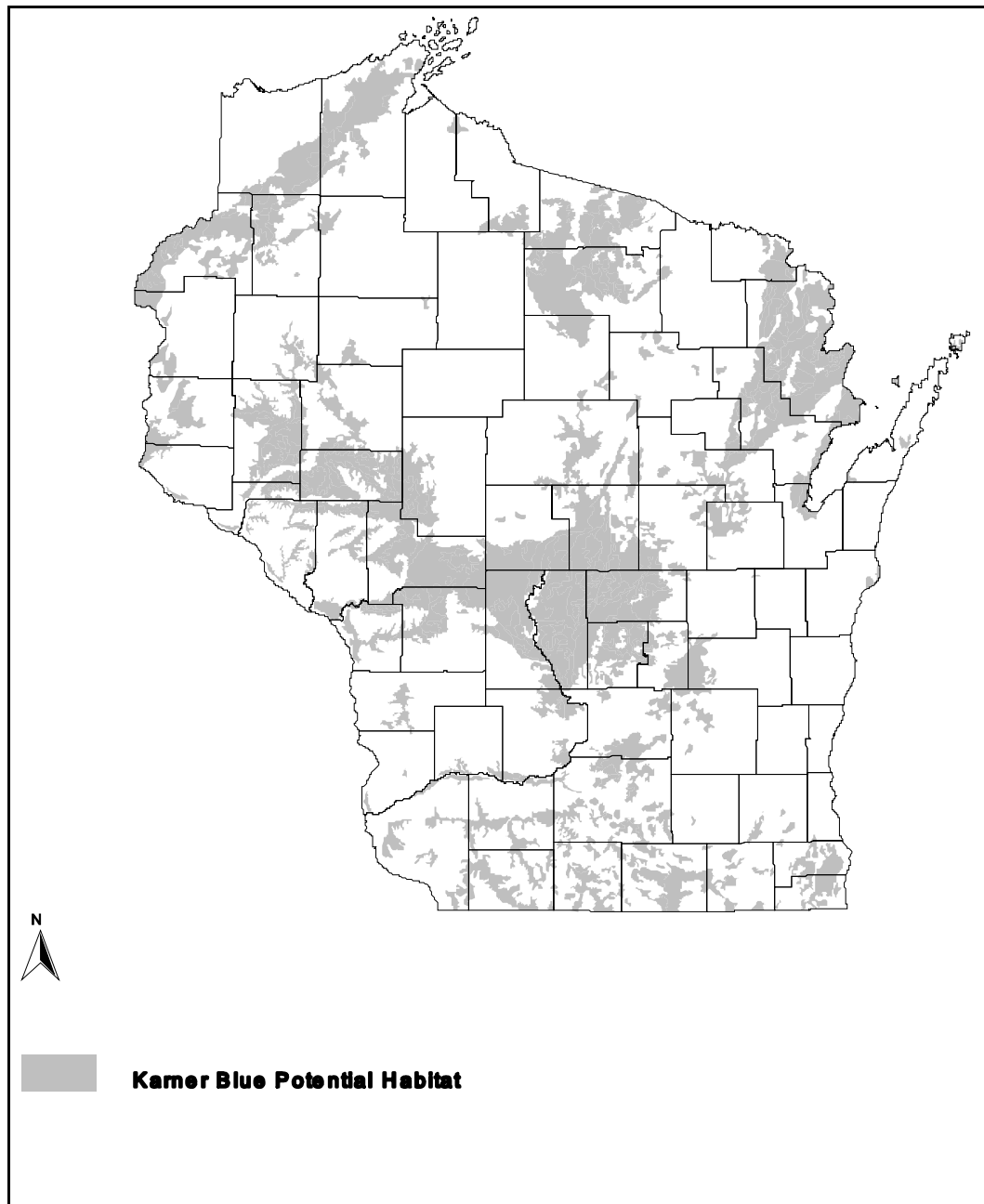
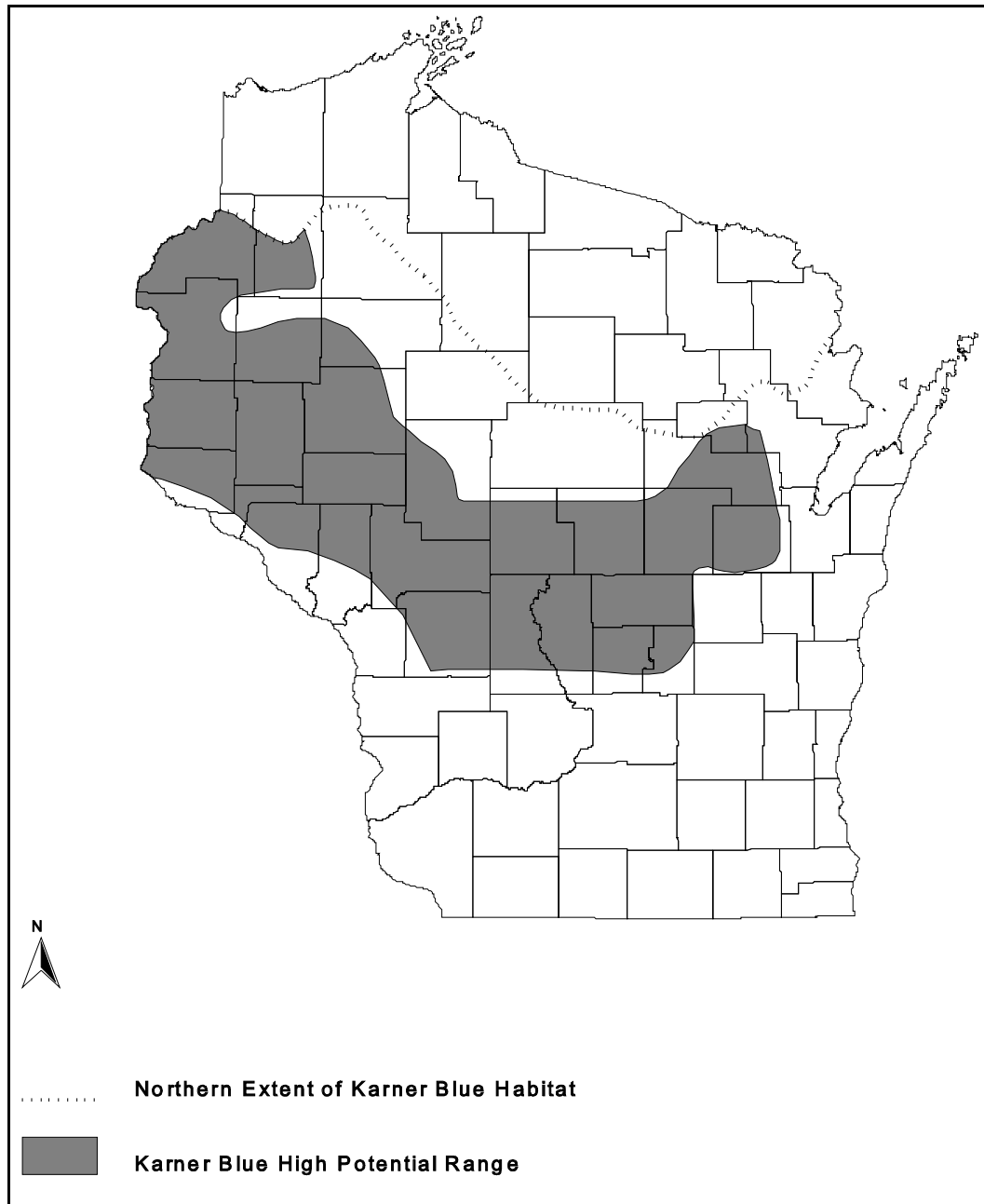


Figure 2.9. Northern Extent (Based on Climatic Data) and High Potential Range of Karner Blue Butterfly in Wisconsin



In October 1995, the Environmental Management Technical Center of the National Biological Service reallocated funds to assist in the refinement of the potential habitat map using climate data. A data set containing daily averages for minimum and maximum temperatures, precipitation, snowfall and evaporation was obtained from the National Climatic Data Center. This refinement attempted to correlate climate factors, known lupine and Natural Heritage Inventory Karner blue butterfly element occurrences.

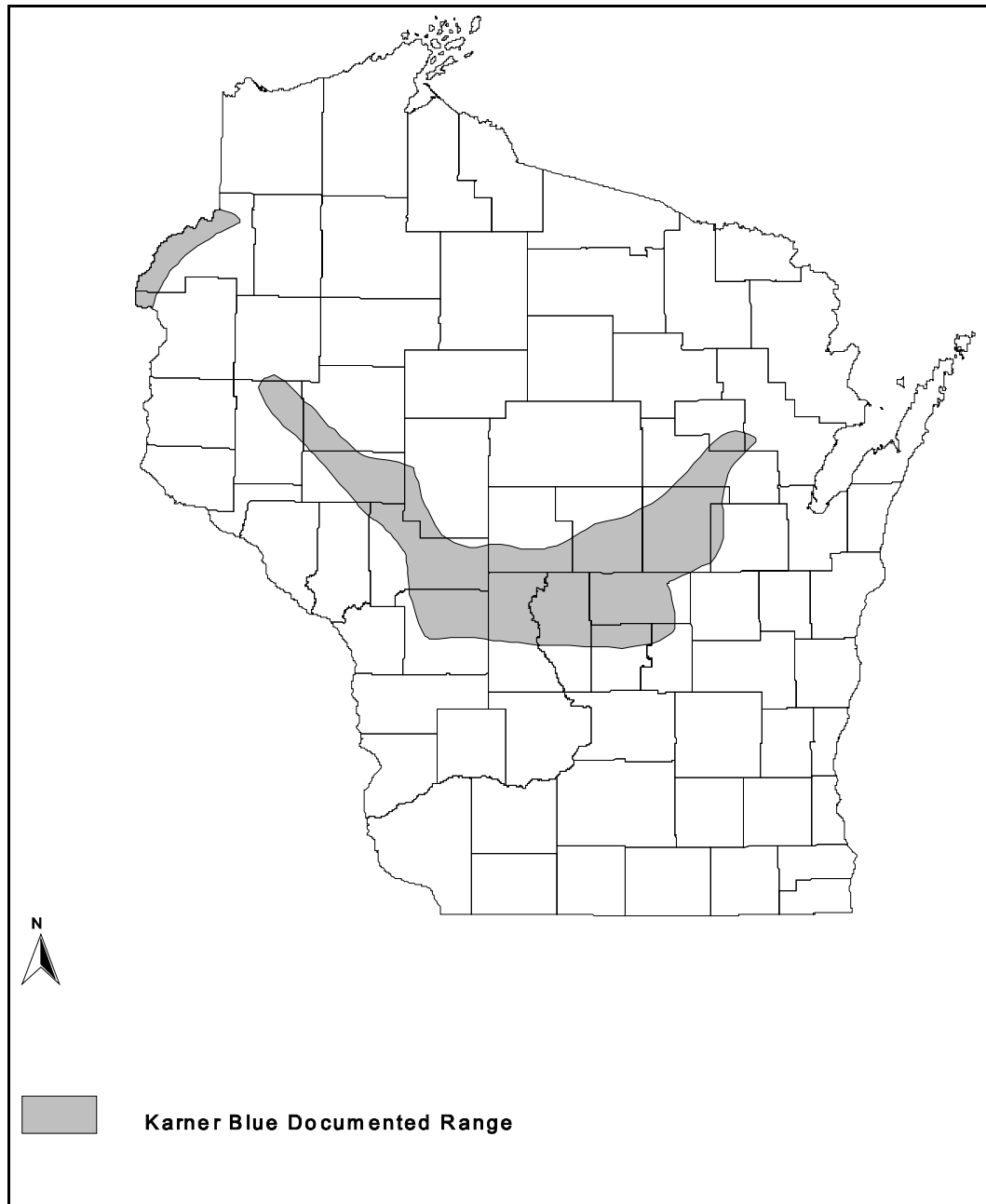
Climate factors in Wisconsin that were evaluated included:

- ☞ average date of first fall frost
- ☞ average date of last spring frost
- ☞ average length of growing season
- ☞ average maximum temperature, May 16 - June 15
- ☞ average maximum temperature, June 16 - July 15
- ☞ average maximum temperature, July 16 - August 15

The combination of the average maximum temperature at or greater than 78 degrees for the period June 16 - July 15 and the average date of last spring frost prior to May 25 provided assistance in the delineation of the northern range of Karner blue butterfly potential habitat (Figure 2.9, page 54). The location of this northern extent line seems reasonable based on the field experience of knowledgeable Karner blue butterfly observers and known 1994 Natural Heritage Inventory butterfly element occurrences. The sandy soil associations north of this line, totaling approximately 2,000,000 acres, are very unlikely to support wild lupine in an abundance that will support Karner blue butterflies. This is probably due to the late spring frosts so common north of this line. The remaining sandy soil associations south of this line total approximately 7,000,000 acres. Of the six climate attributes selected and evaluated, there appears to be no significant limiting factor or combination of factors that delineate the *southern* extent of the Karner blue butterfly potential habitat in Wisconsin.

In July 1996, the HCP Partners agreed to accept Figure 2.10 (page 56) as the documented Karner blue butterfly range in Wisconsin. Figure 2.10 was developed by the HCP Biological Team and is simply a line drawn around the 1994 Natural Heritage Inventory Karner blue butterfly element occurrences. The line is not static, recognizing that the documented range of the Karner blue butterfly may expand or contract as our knowledge increases.

Figure 2.10. Documented Karner Blue Butterfly Range in Wisconsin



4. Distribution and Abundance: Karner Blue Butterfly

Prior to 1990, information on the current status of the Karner blue butterfly in Wisconsin was lacking. Only 36 historical occurrences were known from the state (e.g., there was a 1921 record from Menominee County; in the 1960s, Karner blue butterflies were reported from Burnett County in northwestern Wisconsin [Royer 1962, Shapiro 1969]).

Today, Karner blue butterfly populations in Wisconsin are concentrated across the central counties and in the far northwest on sandy soil areas of Burnett County (Table 2.10, page 58). Figure 1.1 (page 9) depicts Karner blue butterfly element occurrences included in the DNR's Natural Heritage Inventory (NHI) database. An "element occurrence" is a discrete record of Karner blue butterfly occupation as tracked by the NHI; some occurrences may be combined into single populations or metapopulations pending further research on Karner blue butterfly dispersal and behavior. Burnett County is the northern geographical limit of wild lupine (Figure 2.7, page 51) and supports the northern-most Karner blue butterfly population found within its known North American range. As a result, there is little basis for assessing long-term butterfly population trends in Wisconsin.

Historically, Karner blue butterfly populations likely occurred in west central and southeastern Wisconsin, since Karner blue butterflies are still found in eastern Minnesota and along Indiana's Lake Michigan shore. Until recently, Karner blue butterflies were still found along the Lake Michigan shores of northern Illinois near the Wisconsin border. Although the sandy soils in the southern counties of Wisconsin still support wild lupine, repeated surveys of these stands have located no Karner blue butterflies to date. The known range of Karner blue butterflies in Minnesota, Wisconsin, Illinois and Indiana is consistent in terms of growing season climate with the known range further east. Southern Wisconsin's current climatic conditions may be too warm for the butterfly, and it has been speculated that the frequent warm thaws of late winter may cause premature egg hatching (D.F. Schweitzer, The Nature Conservancy, Port Norris, NJ, pers. comm.). Wild lupine occurs as far south as the Florida panhandle, so its presence alone cannot imply that Karner blue butterflies once occurred in the southwestern part of the state. In addition, land use patterns have isolated many remaining wild lupine stands which may also be a factor in the butterfly's absence from this part of the state.

Currently, abandoned agricultural fields, mowed rights-of-way, managed forest lands, military training areas and bombing ranges and managed and unmanaged barrens, savannas and prairies are areas which support wild lupine stands and Karner blue butterflies.

Table 2.10. Wisconsin Counties with Known Karner Blue Butterfly Occurrences (Based on NHI Data through 1996)

Burnett	Monroe	Waushara
Eau Claire	Wood	Waupaca
Clark	Juneau	Marquette
Jackson	Adams	Chippewa
Menominee	Portage	Barron
Oconto	Dunn	Polk
*Sauk	*Kenosha	Shawano
Green Lake	Outagamie	

* records in these counties have not been verified

Wisconsin supports the largest and most widespread Karner blue populations worldwide. More than 270 Karner blue butterfly occurrences are known (C. Bleser, Lepidoptera Coordinator, Bureau of Endangered Resources, pers. comm.), and most can be grouped into about fifteen large population areas. Based on NHI data, most of these larger populations are found on sizable contiguous acreages in central Wisconsin. Karner blue butterfly populations are concentrated in five general regions of the state:

West-Central Wisconsin (southern portion)

(including Jackson County and Black River State Forests and Fort McCoy Military Reservation)

West-Central Wisconsin (northern portion)

(including Eau Claire and Clark County forests)

Central Wisconsin

(including Necedah National Wildlife Refuge, Sandhill State Wildlife Area, Volk Field Air National Guard Hardwood Air to Surface Gunnery Range, Meadow Valley State Wildlife Area and throughout the northern half of Adams County on private lands)

East-Central Wisconsin

(including Hartman Creek State Park area and scattered across the largely agricultural landscape on several smaller public and private properties)

Northwest Wisconsin

(including Crex Meadows State Wildlife Area, Fish Lake State Wildlife Area, Governor Knowles State Forest and Burnett County Forest)

Based on surveys from 1990-1997, the highest known Karner blue butterfly population levels occurring on public lands are found at Crex Meadows and Fish Lake State Wildlife Areas, Eau Claire County Forest, Jackson County Forest, Black River State Forest, Fort McCoy, Necedah National Wildlife Refuge, Sandhill State Wildlife Area and in the Hartman Creek State Park area.

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